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(54) TUBE EXPANDER WITH STOP COLLAR

(71) We, DRESSER INDUSTRIES, INC., a corporation organised under the laws of the State of Delaware, United States of America, of Republic National Bank Building, Dallas, Texas 75221, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention pertains generally to the art of metal deforming and more particularly to tube expanders of the roller and mandrel type for joining tubes into tube sheets.

Tube expanders are widely used by manufacturers of heat exchangers or the like for joining tube ends to headers and are available from a variety of commercial sources. A known roller and mandrel type tube expander is comprised of a tubular cage with three slots in its periphery containing rollers lying at an oblique angle to the cage axis. A rotatable tapered mandrel extends axially through the cage in driving contact with the rollers for rotating the rollers while forcing them operably outward against a tube wall. With the expander initially positioned internally of a tube in engagement against the tube wall, subsequent rotation of the mandrel induces a self-feeding inward movement thereof.

By virtue of the self-feeding aspect that draws the mandrel inwardly, there is a concomitant tendency for the rotating cage to draw the tube away from the member to which it is being fixed. Because of the foregoing it is possible for the tubing to incur an axial advance beyond that which can be tolerated by the expander without interfering with expander operation. Adverse effects of the latter include improper location of the tube and/or severe damage to the expander unit per se. For avoiding those effects, it is known to employ a stop collar of sorts as, for example, disclosed in U.S. Patent 3,426,565. To be effective, a stop collar of the specific construction disclosed in the patent must be located behind the rollers to avoid any gaps through which the tube could penetrate. If located about the rollers, a gap would necessarily be imposed from the clearance provided to avoid roller interference.

According to the present invention there is provided a tube expander including a rotatable tubular cage about which to receive a tube end to be expanded, forming rollers contained in the outer periphery of the cage, a rotatable tapered mandrel within the cage for driving the cage and rollers in an expanding relation to a tube and received thereon, and a stop collar rotatably connected to the cage for limiting axial advance of a received tube end onto the cage, said stop collar comprising a plurality of individual members disposed circumferentially about the cage operably independent of each other and extending into engagement with the periphery of the cage at a predetermined location in the path of tube advance.

The invention will be better understood from the following description of a preferred embodiment thereof, given by way of example only, reference being had to the accompanying drawing, wherein:

Fig. 1 is a side elevation of a tube expander incorporating a stop collar in accordance herewith;

Fig. 2 is a fragmentary view similar to that of Fig. 1 and partially sectioned; and

Fig. 3 is a sectional elevation as viewed substantially along the lines 3—3 of Fig. 2.

Referring now to the drawings, there is shown a tube expander, generally designated 10, positioned internally of a tube 11 to be expanded for secured attachment to a tube sheet or header 12.

Comprising the tube expander is a tapered mandrel 14 adapted to be rotatably driven at its end 15. Positioned about the mandrel to be rotatably driven thereby is a cylindrical cage 16 containing three cylindrical forming rollers 17. The forming rollers are circumferentially displaced in the cage periphery obliquely skewed to its axis and supported on the mandrel to be rotatably driven thereby. Rearwardly of the rollers and likewise positioned about the cage is a thrust collar 18 enclosing a thrust bearing 19. Behind the bearing is a thrust nut 22 positioned on cage threads 23 and coupled to cage 16

via a set screw 24. An annular retainer spring 25 extending into an inward collar recess 26 maintains the components in their assembled relation whereby collar 18 will remain stationary relative to cage 16 which is free to rotate.

Forming thrust collar 18 is a front tubular section 30 closely surrounding cage 16 of internal diameter 32 affording a clearance 33 at least sufficient to clear the circle of maximum expansion afforded by rollers 17. Integrally joined with front section 30 is an enlarged rearward tubular section 31 in which bearing 19 is contained. To preclude or restrict tubing 11, even when of thin wall construction, from being drawn inwardly of the annular clearance between the thrust collar and cage there is provided a stop collar 35.

Comprising stop collar 35 is a plurality of fingers 36. Each of the fingers is of spring wire or the like of about $\frac{1}{8}$ inch diameter formed L-shaped to afford an axially elongated arm portion 37 and a radially extending leg portion 38. The fingers are circumferentially displaced uniformly about the thrust collar 18 with the terminal end of each arm 37 received in a collar aperture 42 whereat the finger is secured by means of a set screw 43. From beneath a set screw 43, each finger arm extends generally in an axial direction toward rollers 17 until laterally offset by leg 38. The legs then passes radially through aperture cutouts 47 flush with the front face of collar 18 until leg end 48 terminates in engagement against the periphery of cage 16 or rollers 17.

The dimension of radial leg 38 is sufficient for end 48 to engage the periphery of cage 16 while causing arm portion 37 to stand outwardly bowed from the periphery of collar tube 30. Being bowed in this manner the finger is maintained in a spring tension biased at all times inwardly against the cage. Since each finger is individually biased independently of the other each will separately track the surface of the rollers and cage moving therepast alternately in their course of rotation. In that manner, the constant engagement between fingers and the rotating periphery collectively precludes any penetration of tube 11 axially beyond engagement with the fingers, even with a tube of thin wall construction.

By the above description, there is disclosed a stop collar construction in a tube expander. The collar 35 is comprised of a plurality of resilient fingers 36 that accurately end track surface rotation of the cage 16 and forming rollers 17. Should tube 11 be of thin wall construction otherwise capable of penetrating clearance 33, the fingers axially located flush with the face of tube 30 collectively effect a lateral barrier against such peneration to inwardly of the thrust collar. By this means, effectiveness of the stop collar is highly reliable yet by virture of its simplicity is relatively uncostly to manufacture affording it decided advantage over competitive expanders having similar purpose stop collar devices.

Since many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that the embodiment shown in the drawings and described above shall be interpreted as illustrative and not in a limiting sense.

WHAT WE CLAIM IS:—

1. A tube expander including a rotatable tubular cage about which to receive a tube end to be expanded, forming rollers contained in the outer periphery of the cage, a rotatable tapered mandrel within the cage for driving the cage and rollers in an expanding relation to a tube and received thereon, and a stop collar rotatably connected to the cage for limiting axial advance of a received tube end onto the cage, said stop collar comprising a plurality of individual members disposed circumferentially about the cage operably independent of each other and extending into engagement with the periphery of the cage at a predetermined location in the path of tube advance.

2. A tube expander according to claim 1 which said members extend radially toward said cage to impose a lateral barrier in interfering relation with the end of a received tube for limiting axial advance thereof.

3. A tube expander according to claim 1 or claim 2 in which said members are operably adapted to follow the rotating periphery of said cage and rollers in a surface tracking relation therewith.

4. A tube expander according to claim 3 in which said members are comprised of a resilient material fixedly supported and radially biased into said surface tracking relation.

5. A tube expander according to claim 3 or claim 4 in which said members comprise individual L-shaped fingers each having one end that terminates in said surface tracking relation.

6. A tube expander according to claim 5 in which said fingers are of a spring wire composition.

7. A tube expander according to claim 5 or claim 6 including a thrust collar having a plurality of apertures in which to receive and support said fingers and means to secure a finger in each of said apertures.

8. A tube expander according to claim 7 in which each of said fingers is comprised of an arm portion generally extending in an axial direction from one of said aper-

tures and a leg portion generally extending in a lateral direction from said arm portion radially toward the periphery of said cage.

9. A tube expander according to claim 8 in which the radial extent of said leg portion is generally greater than the radial distance of said cage periphery to the finger supporting aperture in said thrust collar.

10. A tube expander substantially as herein described with reference to the accompanying drawings.

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1457843 COMPLETE SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

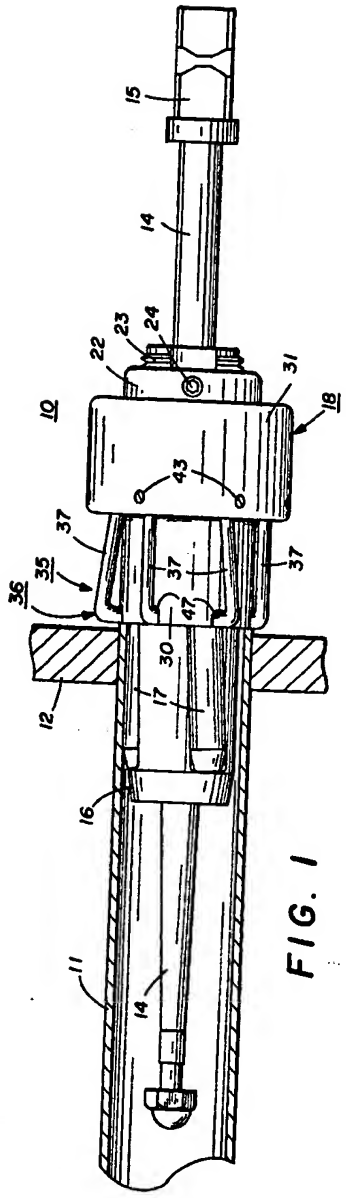

FIG. 1

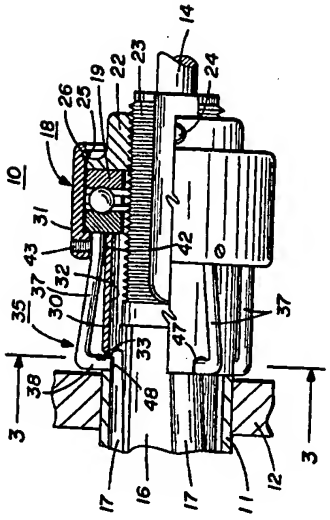

FIG. 2

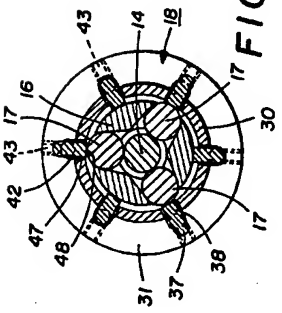

FIG. 3